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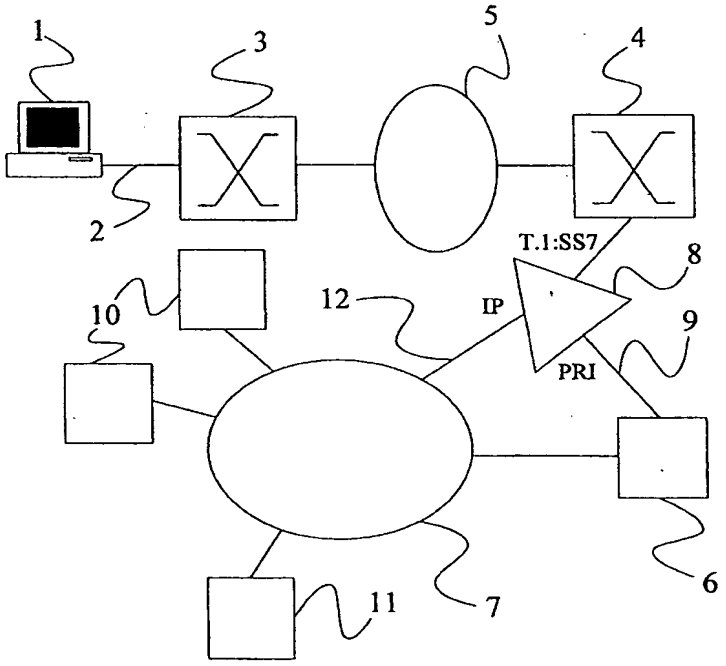
(54) Title: METHOD AND APPARATUS FOR CHARGING IN A COMMUNICATIONS NETWORK

(57) Abstract

A user terminal (1) is connected to the Internet (7) through a telephone network (3, 4, 5) and a Network Access Server (6) operated by an Internet Service Provider (ISP). A protocol converter (8) exists between the telephone network (3, 4, 5) and the Network Access Server (6), and the converter (8) and Network Access Server (6) are coupled through a telecommunication link (9). User data is sent between the converter (8) and the Network Access Server (6) using a circuit switched protocol. Charging data is sent to the converter (8) from a RADIUS server (11) operated by the ISP using Internet Protocol (IP). In response to receipt of this charging data, charging messages are sent from the converter (8) to a billing system (3) of the telecommunications network. On the basis of these messages, the operator of the telecommunications network is able to bill the user for the used ISP services.



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METHOD AND APPARATUS FOR CHARGING IN A COMMUNICATIONS NETWORK

Field of the Invention

The present invention relates to a method and apparatus for charging in a communications network. More particularly, though not necessarily, the invention relates to the provision of charging information to a telecommunications operator from a data network accessible to a subscriber of the telecommunications operator.

Background to the Invention

The conventional way for a home user of a personal computer (PC) to access the Internet is to set up a telephone call, via his telephone operator which provides a modem pool, to an Internet Service Provider (ISP). The access point for the user to the ISP is termed a Network Access Server (NAS). The NAS allocates an Internet Protocol (IP) address to the user PC for the duration of the connection and also acts as a protocol converter, converting the circuit switched data transmissions of the telephone network into IP packet switched transmissions and *vice versa*. A typical ISP may provide many NASs spread over the geographical area in which the ISP operates.

In order to collect billing information and to verify user access rights, the ISP may have a small number of so-called "RADIUS servers" also spread over its coverage area. One RADIUS server may serve a few tens of NASs. Communication between the RADIUS servers and the NASs is carried out using the secure RADIUS protocol (RADIUS stands for Remote Authentication Dial-In User Service

and is defined in IETF standards RFC 2138/2139) A user, who is a subscriber of the ISP, may then be billed for accessing the Internet on the basis of the information collected by the RADIUS server(s).

The Internet access system described above requires that the user has an agreement with the ISP, such that the ISP has information required for charging such as the user's name, address, telephone number etc. This will obviously restrict the number of different ISPs which the user may use.

Summary of the Invention

It is an object of the invention to overcome or at least mitigate the disadvantages of known data network access charging systems. In particular it is an object of the present invention to provide for the combining of telephone and data network charging such that a user may be provided with a single bill for both services.

According to a first aspect of the present invention there is provided a method of charging in a communication network in which a user terminal is connected to a data network through a telecommunications network and a Network Access Server, and in which a protocol converter exists between the telecommunications network and the Network Access Server, and the converter and the Network Access Server are coupled through a telecommunication link, the method comprising:

sending user data between said converter and the Network Access Server, via said telecommunication link, using a circuit switched protocol;

sending charging data from the data network to said converter using a packet switched protocol; and

in response to receipt of said charging data at said converter, sending from the converter to a billing

system of the telecommunications network charging messages on the basis of which the operator of the telecommunications network can bill the user.

Embodiments of the present invention provide a relatively straightforward means by which ISP charging information may be "repatriated" to a user's home telecommunications network. Thus, it is no longer necessary for a user to subscribe directly to an individual ISP, only that the home telecommunications network has an appropriate re-charging agreement with the ISP. As it is possible to incorporate ISP charges into a bill generated by the telecommunications network, it is possible to levy relatively small charges for ISP services.

Preferably, said data network comprises the Internet, and said converter between the telecommunications network and the Network Access Server also comprises an Internet link in addition to said telecommunication link. This allows said charging data to be sent to the converter using Internet Protocol.

More preferably, said data network comprises a Web server arranged in use to store information which is accessible to the user via the telecommunication network and the data network. The data network also comprises one or more charging servers arranged to record user access to the Web servers. Communication between the Web servers and the charging servers may be done using a secure protocol, e.g. RADIUS. Either the web servers, or the charging servers, may be the source of said charging data sent to said converter.

In a preferred embodiment of the present invention, said converter converts Signaling System 7 (SS7) and T.1/E.1

protocol transmissions in the telecommunication network to the Integrated Services Digital Network (ISDN) for transmission to the network access server over said telecommunication link and *vice versa*. Said converter also converts said charging data received from the data network in IP into SS7 protocol charging messages (CRG messages).

Alternatively, the data network may be a Local Area Network (LAN) or a Wide Area Network (WAN).

According to a second aspect of the present invention there is provided apparatus for charging in a communication network in which a user terminal is connected to a data network through a telecommunications network and a Network Access Server, the apparatus comprising:

a protocol converter for placing between the telecommunications network and the Network Access Server, where the converter and the Network Access Server are coupled through a telecommunication link and are arranged to send user data, via said telecommunication link, using a circuit switched protocol; and

charging data generating means for connection to the data network and arranged to send charging data to said converter using a packet switched protocol,

the protocol converter being further arranged, in response to receipt of said charging data at said converter, to send to a billing system of the telecommunications network charging messages on the basis of which the operator of the telecommunications network can bill the user.

Preferably, said protocol converter provides a T.1/E.1:SS7-to-PRI protocol converter between the

telecommunications network and said telecommunication link, and a IP-to-SS7 protocol converter between the telecommunications network and an IP link coupling the converter to the data network. More preferably, the protocol converter is a physically discrete unit which is connected in use between an exchange of the telecommunications network and said telecommunication and IP links.

Brief Description of the Drawings

For a better understanding of the present invention and in order to show how the same may be carried into effect reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows schematically a communications system embodying the present invention; and

Figure 2 shows a flow diagram illustrating the method of operation of the system of Figure 1.

Detailed Description of Embodiments

In the schematic diagram of Figure 1, a PC 1 belonging to a user is connected via a modem of the PC 1 to a subscriber telephone line 2 belonging to a public telephone network. The line 2 connects to an exchange 3 of the network and carries signals according to the Integrated Services Digital Network (ISDN) protocol. This protocol provides the user with two traffic channels (B-channels) and one signalling channel (D-channel).

The exchange 3 is coupled to other telephone exchanges including those belonging to the same network and exchanges belonging to other networks. In order to reach a final destination, a call from the user PC 1 may be routed via several exchanges including the local

exchange 3. Calls between the local exchange 3 are transmitted on 64Kbit/sec channels using E.1 protocol (a Time Division Multiple Access (TDMA) based protocol). Each channel is sub-divided into frames consisting of 31 segments and a single call from the user PC 1 may be allocated 1 segment per frame. As an alternative to the European E.1 protocol, the American T.1 protocol may be used.

A call between the local exchange and some other exchange 4 is set-up using a signalling protocol known as the Signalling System 7 protocol (indicated by reference numeral 5 in Figure 1). This protocol is defined by the ITU standards Q.761 to Q.764 and is carried by a channel made up of 1 segment per TDMA frame.

As has already been described above, in order for a subscriber to a public telephone network to access the Internet, a call must first be set-up between the subscriber's PC 1 and a Network Access Server of an Internet Service Provider. In Figure 1, such a Network Access Server is indicated by the reference numeral 6 and the Internet is indicated by numeral 7. Logging on to the Network Access Server 6 requires a call to be made from the user PC 1 to a telephone number (B-number) allocated by the telephone network to the Network Access Server 6. The call is routed through the local exchange 3 to the exchange 4 closest to the Network Access Server 6 using the SS7 signalling protocol as described above. The call is then routed through a converter unit 8 to a telephone line 9 connected to the Network Access Server 6 where access to the user PC 1 is granted on the basis of the subscriber number (A-number) transmitted as part of the call set-up procedure. Alternatively, access may be granted on the basis of a username and password entered by the subscriber.

In order to provide sufficient capacity to cope with a number of simultaneous Internet access requests, the telephone line 9 carries ISDN protocol signals according to the Primary Rate Interface (PRI), providing 30 B traffic channels and 1 D signalling channel. The Converter unit 8 therefore acts as an E.1/SS7-to-PRI protocol converter and *vice versa*.

Figure 1 shows two Web servers 10 on which are stored Web pages and other information accessible to a user via the Internet 7. It will be appreciated that a large number of Network Access Servers and Web servers will be separately coupled to the Internet 7.

In addition to controlling the Network Access Server 6, and possibly a number of Web servers 10, the ISP also has control of a RADIUS server 11. The RADIUS server 11 is so-called because it communicates with the Web servers 10 using a secure communication protocol known as RADIUS (although any other suitable Authentication-Authorisation-Accounting (AAA) protocol may be used)). The RADIUS server 11 acts as a billing co-ordinator for the Network Access Server 6 and a group of Web servers 10. More particularly, the RADIUS Server 11 receives caller identity information from the Network Access Server 6 (more particularly the access port ID of the subscriber into the Network Access Server and possibly the subscriber's A-number) together with call start and stop times. The RADIUS Server 11 also receives from the Web Servers 10 charging information relating to specific services provided by the Web servers 10 to the user. These services may include accessing premium rate services such as Web pages giving up-to-the-minute sports and business information, or accessing Web servers 10 located in a foreign country.

In order to allow the user to be billed on the basis of the information collected by the RADIUS server 11, the RADIUS Server 11 sends charging data to the converter unit 8 via an Internet link 12. The Converter unit 8 is for this purpose allocated an IP address and the link 12 uses the well known IP protocol. The IP address is sent to the RADIUS server 11 by the Network Access Server 6 during the initial connection phase. The protocol stack in this link comprises RADIUS over UDP over IP.

Upon receipt of the charging data from the RADIUS server 11, the converter unit 8 generates charging messages which are transmitted via the exchange 4 to the subscriber's local exchange 3 (or to some other billing coordinator of the public telephone network). The charging messages are in fact CRG messages as defined in SS7 standard Q.762 (although for example conventional charging "pulses" may be used instead). In addition to providing a E.1:SS7-to-PRI protocol converter, the converter unit 8 therefore also provides an IP-to-SS7 protocol converter.

It will be appreciated by the person of skill in the art that various modifications may be made to the above described embodiment without departing from the scope of the present invention. For example, charging data may be sent directly from the Web servers 10 to the converter unit via the Internet link 12, rather than through the RADIUS server 11. An Internet Service Provider may also utilise a number of different RADIUS Servers, each serving a particular group of Network Access Servers and/or Web servers.

It will also be appreciated that whilst the embodiment described above considers the Web servers, RADIUS

servers, and Network Access Server to be connected together via the Internet, this need not be so. The connections may be made via some other data communication links, e.g. lines leased by the ISP from a telecommunications network or a LAN or WAN owned by the ISP. Similarly, the link between the RADIUS server 11 and the converter 8 may be made via a data link which does not form part of the open Internet network.

Claims

1. A method of charging in a communication network in which a user terminal is connected to a data network through a telecommunications network and a Network Access Server, and in which a protocol converter exists between the telecommunications network and the Network Access Server, and the converter and the Network Access Server are coupled through a telecommunication link, the method comprising:

sending user data between said converter and the Network Access Server, via said telecommunication link, using a circuit switched protocol;

sending charging data from the data network to said converter using a packet switched protocol; and

in response to receipt of said charging data at said converter, sending from the converter to a billing system of the telecommunications network charging messages on the basis of which the operator of the telecommunications network can bill the user.

2. A method according to claim 1, wherein said data network comprises the Internet, and said converter between the telecommunications network and the Network Access Server comprises an Internet link in addition to said telecommunication link, whereby said charging data is sent to said converter using Internet Protocol.

3. A method according to claim 2, wherein said data network comprises a Web server arranged in use to store information which is accessible to the user via the telecommunication network and the Internet.

4. A method according to claim 3, wherein the data network comprises one or more charging servers arranged to record user access to the Web servers.

5. A method according to claim 4, wherein communications between the Web servers and the charging servers are done using a secure protocol.

6. A method according to claim 4 or 5, wherein either the web servers, or the charging servers, are the source of said charging data sent to said converter.

7. A method according to any one of the preceding claims, wherein said converter converts Signaling System 7 (SS7) and T.1/E.1 protocol transmissions in the telecommunication network to the Integrated Services Digital Network (ISDN) for transmission to the Network Access Server over said telecommunication link and *vice versa*.

8. A method according to claim 7 when appended to claim 2, wherein said converter converts said charging data received from the data network in IP into SS7 protocol charging messages (CRG messages).

9. Apparatus for charging in a communication network in which a user terminal (1) is connected to a data network (7) through a telecommunications network (3,4,5) and a Network Access Server (6), the apparatus comprising:

a protocol converter (8) for placing between the telecommunications network (3,4,5) and the Network Access Server (6), where the converter (8) and the Network Access Server (6) are coupled through a telecommunication link (9) and are arranged to send user data, via said telecommunication link (9), using a circuit switched protocol; and

charging data generating means (11) for connection to the data network (7) and arranged to send charging

data to said converter (8) using a packet switched protocol,

the protocol converter (8) being further arranged, in response to receipt of said charging data at said converter (8), to send to a billing system (3) of the telecommunications network charging messages on the basis of which the operator of the telecommunications network can bill the user.

10. Apparatus according to claim 9, wherein said protocol converter (8) provides a T.1/E.1/SS7-to-PRI protocol converter between the telecommunications network (3,4,5) and said telecommunication link (9), and a TCP/IP-to-SS7 protocol converter between the telecommunications network (3,4,5) and an IP link (12) coupling the converter (8) to the data network (7).

11. Apparatus according to claim 9, wherein the protocol converter (8) is a physically discrete unit which is connected in use between an exchange (4) of the telecommunications network (3,4,5) and said telecommunication and IP links (9,12).

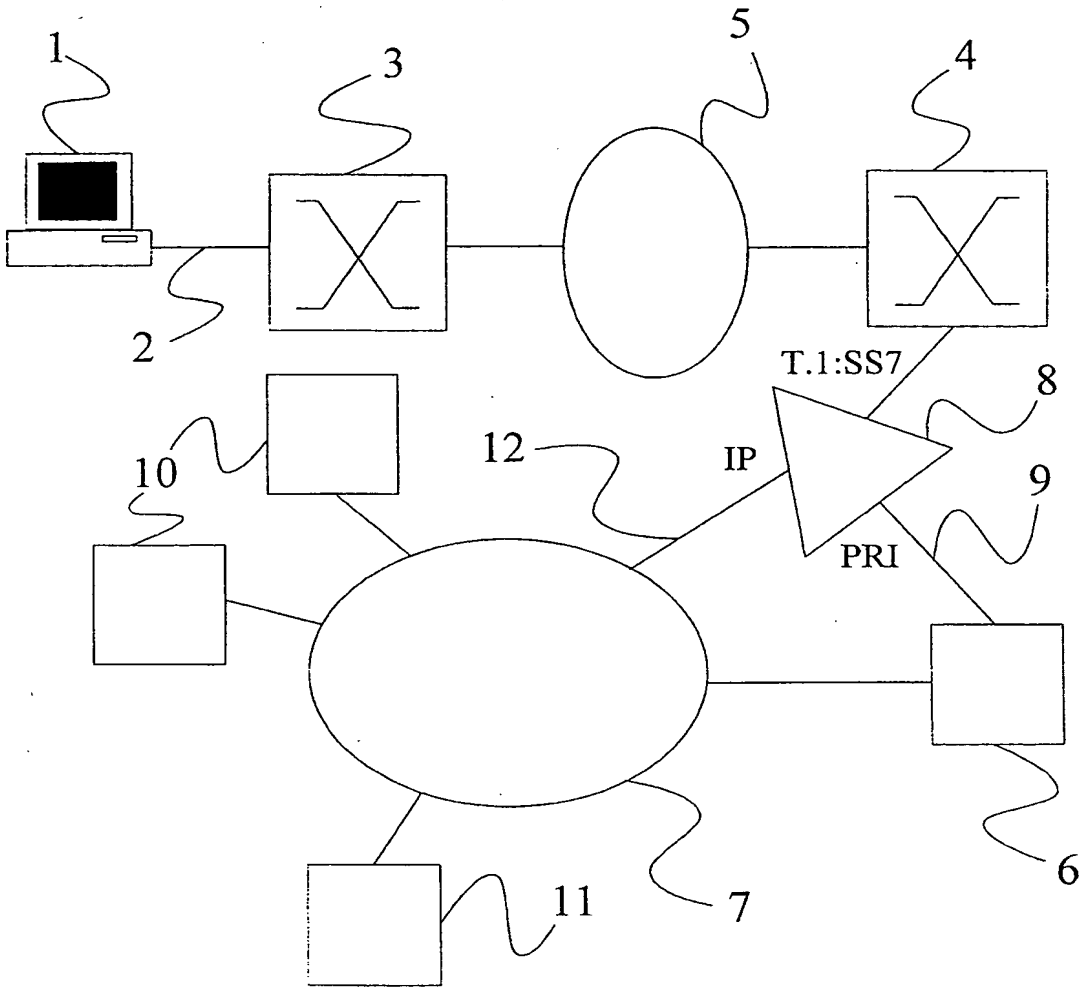

Fig. 1

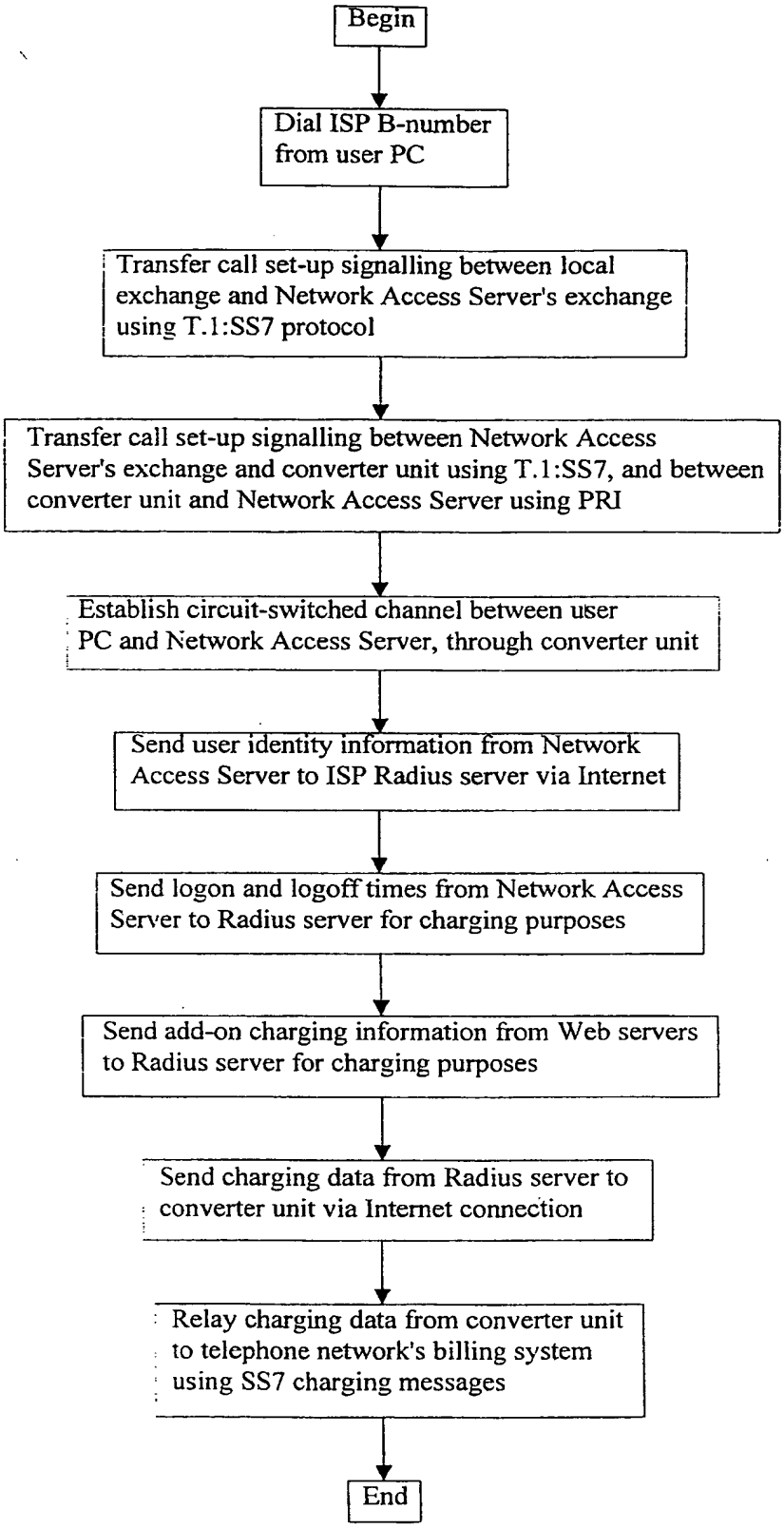
Begin
Dial ISP B-number from user PC
Transfer call set-up signalling between local exchange and Network Access Server's exchange using T.1:SS7 protocol
Transfer call set-up signalling between Network Access Server's exchange and converter unit using T.1:SS7, and between converter unit and Network Access Server using PRI
Establish circuit-switched channel between user PC and Network Access Server, through converter unit
Send user identity information from Network Access Server to ISP Radius server via Internet
Send logon and logoff times from Network Access Server to Radius server for charging purposes
Send add-on charging information from Web servers to Radius server for charging purposes
Send charging data from Radius server to converter unit via Internet connection
Relay charging data from converter unit to telephone network's billing system using SS7 charging messages
End

Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No
Pc./EP 99/03429

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07F7/10

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,A	WO 99 08242 A (BRITISH TELECOMMUNICATIONS) 18 February 1999 (1999-02-18) page 4, line 13 - line 18 page 5, line 22 -page 6, line 29; figures ---	1-11
P,A	EP 0 848 361 A (NIXU) 17 June 1998 (1998-06-17) column 6, line 26 - line 38 column 10, line 22 - line 45 column 13, line 41 - line 48 abstract; figures 3-8 ---	1-11
A	EP 0 765 068 A (AT&T) 26 March 1997 (1997-03-26) column 6, line 39 -column 7, line 56; figures 1-4 --- -/--	1-11

[X] Further documents are listed in the continuation of box C.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication.where appropriate, of the relevant passages	Relevant to claim No.
A	WO 96 37848 A (WALKER ASSET MANAGEMENT) 28 November 1996 (1996-11-28) page 13 page 15, line 22 -page 16, line 36; figures	1-11
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A	WO 97 01920 A (TELECOM FINLAND) 16 January 1997 (1997-01-16) abstract; figures	1-11

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